

LII.—Notes on some Ganoid Fishes from the English Lower Lias. By A. SMITH WOODWARD, F.G.S., F.Z.S., of the British Museum (Natural History).

[Plate XVI.]

THE accumulated discoveries of many years, preserved in several Museums, afford the opportunity for a revision of our knowledge of the Fish-fauna of the English Lower Lias, and also make known a few interesting forms as yet unrecognized. Having had frequent opportunities of pursuing the subject during the last few years, the writer ventures to offer the following remarks on some of these new and little-known fishes—the result of observations chiefly based on specimens in the British Museum.

I. Family Palæoniscidæ.

As already remarked by Traquair *, the Palæoniscidæ of the Lias comprise the four fishes described by Egerton under the names of *Oxygnathus ornatus*, *Cosmolepis Egertoni*, *Thrissonotus Colei*, and *Centrolepis asper*. A fifth genus and species, *Lissolepis serratus* of Davis, is also described as referable to the same family; but there seems to be no justification for this determination, and the fish in question has lately been removed to the Eugnathidæ †.

Genus CENTROLEPIS.

Of the undoubted Palæoniscidæ the genus *Centrolepis* is the most striking and well characterized. It is, however, very rare, there being only three specimens in the British Museum; and the caudal pedicle and fins still remain unknown. The new examples show that the type species, *Centrolepis asper*, is not so short and stout as supposed by Egerton; the fin described as anal being truly one of the pelvic pair, while the marginal rays ascribed to the lower lobe of the caudal fin are undoubtedly those of the anal. Moreover, the scales described and figured in the original notice are all referable to the ventral aspect, those of the flank (Pl. XVI. fig. 1) being somewhat deeper in proportion to their

* R. H. Traquair, "Ganoid Fishes of the British Carboniferous Formations," pt. i. (Pal. Soc., 1877), p. 12.

† Woodward and Sherborn, "Catalogue of British Fossil Vertebrata" (1890), p. 77. Complete references to the literature of the subject under consideration will be found in this work.

width, and with less radiating markings. In short, the more important known facts in the skeletal anatomy of this fish may now be summarized as follows:—

Trunk fusiform, robust, and somewhat elongated. Mandibular suspensorium oblique; dentition consisting of an inner series of large conical teeth, well spaced but numerous, and an outer close series of smaller teeth, similar in form; head, opercular, and branchiostegal bones externally tuberculated or rugose. Fins large, consisting of broad, flattened rays, all articulated and distally bifurcating, more or less coated with ganoine; anterior borders fringed with well-developed fulcra. Dorsal and anal fins triangular in shape, elevated, the dorsal opposed to the space between the pelvic fins and the anal. Scales thick, of moderate size, and highly ornamented; not much deeper than broad upon the middle of the flank, as deep as broad on the ventral aspect. Each scale of the abdominal region marked in its hinder half by coarse postero-inferiorly directed ridges and sharp denticulations, in its anterior half by few, irregular, more or less interrupted vertical ridges and furrows; the scales of the caudal region coarsely serrated posteriorly, with a few short, transverse sculpturings anteriorly.

Genus OXYGNATHUS.

The facts made known in Egerton's description of *Oxygnathus* suffice to demonstrate the right of the type species to generic distinction, although the "diagnosis" is as unsatisfactory as most of those in early palæichthyological writings. The figure (Egerton's pl. ix.), however, exhibits some inaccuracies, the pectoral fin-rays being unarticulated except at the extremities, as correctly noted in the description; the striations upon the jaws not being regular parallel lines, but short and wavy fine ridges, irregularly anastomosing and bifurcating; while the supposed indications of "ossified vertebræ" are either small pleurocentra and hypocentra, or, as seems more probable, merely the expanded bases of the arches.

A new diagnosis of the genus, based upon the original description and the examination of the large series of examples in the British Museum, may thus be enunciated in the following terms:—

Trunk elegantly fusiform, more or less elongated. Mandibular suspensorium oblique; dentition consisting of a series of large, well-spaced conical teeth, and numerous minute teeth irregularly arranged and somewhat clustered; cranial roof-bones finely tuberculated, sometimes rugose, the facial

bones and branchiostegal rays delicately striated, and the opercular bones almost smooth. Fins of moderate size or small, the rays broad, distally bifurcating, and more or less covered with a very thin layer of ganoine; the rays of the pectoral fins, except the few short ones placed hindmost, articulated only at the distal extremities, all others uniformly articulated to the base; fulcra minute or absent. Dorsal and anal fins triangular in shape, somewhat longer than high, and the hinder rays very short; dorsal opposed to the space between the pelvic and anal fins; upper caudal lobe narrow and much attenuated, with small ridge-scales, the fin deeply forked and symmetrical. Scales thick, small, or of moderate size, very narrow ventrally, and ornamented with delicate, oblique lines of ganoine, in part bifurcating and branching, becoming very faint upon the anterior dorso-lateral region and partly subdivided into tubercles.

The only character of generic value in *Oxygnathus ornatus* that still remains doubtful is the relative length of the anal fin, no known specimen exhibiting this appendage so satisfactorily as desirable. That it will prove to be elongated, however, seems evident from the fact that in every other generic character the so-called *Cosmolepis Egertoni* is identical with *Oxygnathus*, and the elongation of the anal fin is distinct in the type specimen of that fish. Moreover, the so-called *Thrissonotus Colei* is not separated from *Oxygnathus ornatus* even by specific characters, and in this case the anal fin is again distinctly elongated. This fish owes the peculiarities of its squamation entirely to the fact that it occurs in a very hard nodule, which has split in such a manner as to destroy the superficial scale-ornament, and exhibit the structural lines of growth. All the ordinary specimens of *Oxygnathus ornatus* occur in the well-known soft Lias clay, and thus exhibit the superficial ornamentation more or less intact.

To the synonymy of *Oxygnathus ornatus* the present writer would thus relegate the so-called *Thrissonotus Colei*, the species being as yet known only from the Lower Lias of Lyme Regis; and the more deeply fusiform species, hitherto named "*Cosmolepis*," may be termed *Oxygnathus Egertoni*, this being at present peculiar to the Lower Lias of Barrow-on-Soar.

Genus COCCOLEPIS.

Three imperfectly preserved specimens in the British Museum indicate the occurrence of a new small Palæoniscid

fish in the Lower Lias of Lyme Regis; two of these specimens being tolerably complete, but the third wanting the head and the greater part of the abdominal region, while apparently shortened by accidental crushing. The principal characters of the genus and species are shown in the accompanying Pl. XVI. figs. 2-4.

The maximum depth of the trunk is contained about four and a half times in the total length, which does not exceed 0·135. The *head* (Pl. XVI. figs. 2, 3) is longer than deep, it and the opercular apparatus together being comprised about four and a half times in the total length. The orbit is large and far forwards, and the snout projects somewhat in advance of the mouth. The mandibular suspensorium is very oblique and the jaws are slender, with a wide gape. The mandible is pointed at the symphysis and bears two rows of teeth, the inner series consisting of large, regular, well-spaced, conical teeth, somewhat curved, and the outer series comprising numerous closely arranged minute teeth. The dentition of the upper jaw is smaller than that of the lower, though the inner row is similar in character and the outer row is not clearly recognizable. The cranial and facial bones are ornamented with coarse rounded tuberculations, which are rarely elongated and fused into short rugæ; and these tuberculations become more sparse on the operculum and suboperculum. The operculum (fig. 3, *op.*) is much smaller than the suboperculum, and the latter element is deeper than broad.

The vacant space occupied by the *notochord* is distinct in the original of fig. 2, and there are no undoubted ossifications in the notochordal sheath. In the abdominal region there are not less than twenty-eight segments, represented by well-developed neural arches and relatively minute hæmal cartilages. Each of the neural arches is robust, but elongated, much expanded at its base, less expanded distally, and bearing a long, slender, neural spine, which is merely apposed and not in direct connexion; the representatives of the hæmal arches are merely small expansions, each with a vertical ridge. In the caudal region both the neural and hæmal arches are complete and apparently more ossified than those of the abdominal region; the arches are all short and robust, and in each case the spine is evidently directly fused with its supporting pedicles. At the inferior lobe of the caudal fin the hæmal spines become expanded for the support of the dermal rays, and at the base of the upper lobe there is a series of interspinous bones supporting the large fulcral scales.

All the *fins* are made known in the specimens under consideration. The pectoral fins are not excessively large, and

all the rays are articulated at distant intervals. The pelvic fins also consist of robust articulated rays, are situated nearer to the anal than to the pectorals, and are not much inferior in size to the latter; their height seems to be greater than the length of their base-line. The more anterior rays of the dorsal and anal fins and the lower lobe of the caudal are especially robust and covered with ganoine, and fulcra are only distinctly observed on the caudal. The dorsal fin arises at the middle point of the back, opposite the hinder half of the pelvic fins, and is elevated and triangular-acuminate in shape, the length of its base-line not exceeding its height. The anal fin is relatively small and low, its height equalling only half that of the dorsal, and its length being only about three quarters that of the latter. The caudal fin is deeply forked and not quite symmetrical, the much attenuated upper lobe being somewhat larger than the lower.

The scales are small and thin, and the proportions of those of the abdominal region are well shown in the original of Pl. XVI. fig. 2. They are not deepened upon the flank, and, as shown by no. 39865 (Pl. XVI. figs. 4, 4*a*), the external ornament consists of numerous rounded tuberculations of ganoine. They appear as if rounded posteriorly and overlapping. The fulcral scales of the upper caudal lobe are very large, with slight longitudinal sculpturings.

Determination.—On selecting from the characters thus detailed those that seem to be of generic value it will be observed that the fish approaches most closely the small round-scaled Palæoniscid *Coccolepis**, from the Lithographic Stone of Bavaria. Judging from the elaborate description of the latter genus by Vetter†, the new Liassic species exhibits only one essential difference from the typical form, namely the articulation of the pectoral fin-rays. These rays, however, have only been partially seen in a single example of *Coccolepis Bucklandi*; and, as it is sometimes difficult to recognize the delicate transverse sutural lines even in well-preserved examples, we venture to place the Liassic fish in the same genus until more satisfactory specimens of the type species are discovered. The Rev. W. R. Andrews, F.G.S., has presented to the Museum of Practical Geology a species of *Coccolepis* from the Purbeck Beds of the Vale of Wardour‡, but this has not yet been described; and *C. Bucklandi* thus remains the sole representative of the genus bearing a defined

* L. Agassiz, Rech. Poiss. Foss. vol. ii. pt. i. (1843), p. 300.

† B. Vetter, "Die Fische aus dem lithographischen Schiefer," Mittheil. k. min.-geol. Mus. Dresden, pt. iv. (1881), p. 37, pl. i. fig. 2.

‡ Woodward and Sherborn, *op. cit.* p. 37.

specific name. From this the fish now made known is distinguished by the more remote situation and relatively smaller size of the dorsal fin, and probably by less conspicuous characters at present imperfectly revealed. The name of *Coccolepis liassicus* is thus proposed for the new species, in reference to its stratigraphical position.

II. Family Cœlacanthidæ.

Genus UNDINA.

Well-preserved examples of a large Cœlacanth Ganoid (*Holophagus gulo*) have already been described by Egerton and Huxley from the Lower Lias of Lyme Regis; but no member of the same family has hitherto been detected in a corresponding horizon elsewhere. The British Museum, however, now furnishes evidence of a distinct species from the Lower Lias of Barrow-on-Soar, Leicestershire; and, although the specimen is not so satisfactorily preserved as desirable, it exhibits several features specially worthy of note in comparison with the Cœlacanthis both of earlier and later date. The fossil occurs on counterpart slabs, and one is shown, of the natural size, in Pl. XVI. fig. 5.

The head and the greater portion of the trunk are exhibited from the lateral aspect, the anal and paired fins only being entirely wanting. The head and opercular bones, so far as preserved, do not exhibit any external ornamentation, though some rounded pittings in an impression of the operculum may possibly indicate the presence of a few large rounded tubercles upon that bone. Above the orbit a series of small quadrangular plates (*x*) may be either parafrontals or sclerotics; and one of the pterygo-quadrates (*ptq.*) is seen, with obscure traces of small conical teeth. The impression of the inner aspect of one of the jugular plates (*ju.*) is also distinct, proving that bone to have been narrow and elongated, nearly four times as long as its maximum width. The first dorsal fin (*d*¹) exhibits not less than seven very long stout rays, articulated in the distal half, and the anterior margin of the first ray is fringed by well-developed upward-pointing denticles*. The second dorsal (*d*²), though much broken, is evidently smaller than the first and consists of very slender rays. The hinder half of the caudal region is displaced, almost severed from the rest of the fish, and partly destroyed. Sixteen rays can be distinctly counted in the

* These denticles are scarcely seen on the slab figured, but are distinct on the counterpart.

upper half of the principal caudal fin (*c*), these rays being articulated, though not expanded, distally; and there are remains of a well-developed supplementary caudal fin (*sc*). The squamation is only preserved in the anterior half of the abdominal region and at the base of the supplementary caudal fin, each scale being ornamented with four to six large elongated tubercles, irregularly arranged in an antero-posterior direction, and sometimes subdivided transversely (fig. 5 *a*).

Determination.—The fish thus described is closely similar in proportions and in the character of its fin-rays to the typical *Celacanthus*; but it is generically distinguished by the presence of denticles upon the first dorsal fin and by the scale-ornament. With the Jurassic genus *Undina**, however, it agrees in every essential particular except the non-expansion and comparatively sparse articulation of the distal half of the fin-rays; and as these characters are of doubtful value, it seems advisable, at least provisionally, to place the Barrow species in the well-known genus just mentioned. To the present writer it appears that no sufficient generic difference has yet been pointed out between the so-called *Holophagus* and *Undina*; but the new fossil now described is distinguished both from the Lyme Regis fish and the typical species of the Bavarian Lithographic Stone by the characters of the fin-rays and scales and by the comparative fewness of the caudal fin-rays. The specimen may thus be regarded as indicating a hitherto unknown species, for which the name of *Undina barroviensis* will be appropriate.

EXPLANATION OF PLATE XVI.

- Fig. 1.* *Centrolepis asper*, Egerton. Scales of flank, twice nat. size. Lower Lias, Lyme Regis. [B. M., no. P. 5594.]
- Fig. 2.* *Coccolepis liassicus*, sp. nov. Lateral aspect of fish. *Ibid.* [B. M., no. P. 887.]
- Fig. 3.* Ditto. Head, lateral aspect, twice nat. size. *Ibid.* [B. M., no. P. 6153.] *br.*, branchiostegal rays; *md.*, mandible; *mx.*, maxilla; *orb.*, orbit; *op.*, operculum; *pect.*, pectoral fin.
- Fig. 4.* Ditto. Caudal region, lateral aspect. *Ibid.* [B. M., no. 39865.]
- Fig. 4 a.* Scale of ditto, three times nat. size.
- Fig. 5.* *Undina barroviensis*, sp. nov. Lateral aspect of fish. Lower Lias, Barrow-on-Soar. [B. M., nos. 21335, P. 3343.] *c*, principal caudal fin; *d¹*, *d²*, first and second dorsal fins; *ju.*, jugular plate; *ptq.*, pterygo-quadrato bone; *sc*, supplementary caudal fin; *x*, parafrontal (? or sclerotic) plates.
- Fig. 5 a.* Scales of ditto, three times nat. size.

[B. M.=British Museum. Unless otherwise stated the figures are of the natural size.]

* G. von Münster, Neues Jahrb. 1834, p. 539, and Beitr. Petrefakt. pt. v. (1842). p. 57.